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History Sheet

Rev	Reason for revision	Revised by
0	Initial issue.	R. Haggard
1	Document is revised to incorporate comments received during Ecology's review of revision 0 of the document. Sections 1, 3, and 8 were revised to incorporate expanded discussions of new National Ambient Air Quality Standards and expanded discussion of Ambient Air Impact Analysis for the new NAAQS for emissions of NO_x, SO_2, and $PM_{2.5}$. Minor editorial changes throughout the document.	

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1 Introduction

This Prevention of Significant Deterioration (PSD) Permit Application Supplement (Application Supplement) is being re-submitted to the Washington State Department of Ecology (Ecology) to support approval of planned design changes associated with the Hanford Tank Waste Treatment and Immobilization Plant (WTP) that will impact PSD-02-01, Amendment 2. The revised document incorporates expanded discussions relating to greenhouse gas emissions and revised ambient air impact analysis associated with the Environmental Protection Agencies new National Ambient Air Quality Standards (NAAQS) for emissions of nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter sized at 2.5 microns or less ($PM_{2.5}$).

The new source review requirements under PSD apply to the WTP because the maximum potential emissions of NO_x exceeded the significance threshold of 40 tons per year and emissions of PM_{10} [particulate matter] exceeded the significance threshold of 15 tons/per year. Other criteria pollutant emissions were estimated to be below the PSD significance emission rates and were permitted under a separate minor new source review permit DE02NWP-002 issued by Ecology's Nuclear Waste Program.

The original PSD-02-01 was approved by Ecology on July 2, 2002, and allowed start of construction of the WTP with a design consisting of a pretreatment facility (PTF), three (3) Low Activity Waste (LAW) facility melters, one (1) High Level Waste (HLW) facility melter, nine boilers, a diesel fire pump, and six emergency diesel generators. Amendment 1 of PSD-02-01 was issued on November 4, 2003 to incorporate a redesigned WTP that included reducing the number of LAW facility melters from three (3) to two (2); increasing the number of HLW facility melters from one (1) to two (2); changing the size and number of boilers from nine to six; reducing the number of emergency generators from six to three; and changing the number of diesel firewater pumps from one to two. Amendment 2 was issued on October 12, 2005 to eliminate the restriction on hours of operation on the steam boilers and replace it with a restriction in the gallons of fuel burned.

Today's Application Supplement proposes to eliminate the Type II emergency diesel generators from design and replace them with turbine generators for emergency power production. The Application also proposes an increase to the annual operating hour restriction for each of the diesel engine-driven fire pumps from 110 hour per year to 230 hour per year to support maintenance and testing of WTP fire water systems. All other WTP emissions units, including the Type I emergency diesel generator, remain unchanged and continue under construction.

Section 5 and Appendix A provide an emissions analysis that compares existing maximum projected WTP criteria pollutant emissions of PM, PM_{10}, $PM_{2.5}$, NO_x, CO, SO_2, and VOC to those resulting from the proposed changes. The analyses in Tables 5-1 and 5-2 demonstrate that the maximum projected emissions from both the turbine generators and fire pump engines are below PSD significant emission rates. The proposed project reduces NO_x emissions by approximately 3 tons per year and particulate matter by less than a ton per year. Slight increases in maximum projected CO, SO_2, and VOC emissions result from the changes but emissions are well below PSD significance levels.

Note that particulate matter emissions from the existing project were all assumed to be PM_{10} while the proposed project projects emission rates for comparison to recently finalized EPA emission standards for $PM_{2.5}$ and green house gas (GHG) for the turbines and fire pumps. The analysis shows maximum projected emissions of $PM_{2.5}$ at 0.05 tons/yr which is below the PSD significance threshold of 10 tons/yr, and GHG emissions at 1,432 tons per year which is less than the PSD significance threshold of 75,000 tons per year for modified existing sources already subject to PSD.

Since issuance of the existing PSD-02-01, Amendment 2, the Environmental Protection Agency has published new National Ambient Air Quality Standards (NAAQS) for NO_2, SO_2, and $PM_{2.5}$. Because the WTP project is proposing a change to PSD-02-01, these standards must be assessed to evaluate whether the proposed project plus background concentrations exceed any of the NAAQS. Section 8 contains a complete NAAQS ambient air impact analysis and demonstrates that the WTP contribution to the background concentrations are less than the NAAQS.

In parallel with this PSD Application Supplement, a separate Nonradioactive Air Emissions Notice of Construction Permit Application Supplement will be submitted to Ecology's Nuclear Waste Program to address emissions of criteria pollutants less than PSD thresholds and Toxic Air Pollutant emissions affecting DE02NWP-002.

The Application Supplement is prepared consistent with the requirements cited in WAC 173-400-700, *General Regulations for Air Pollution Sources* and 40 CFR 52.21, *Prevention of Significant Deterioration of Air Quality*, for control of potential criteria pollutant emissions. The format of the Application is prepared based on pre-application discussions with Ecology Headquarters staff. The Application Supplement is a supplement to the existing *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT-ENV-01-007, Rev. 1, instead of a replacement. This approach was based on the following:

- An overall WTP emissions reduction of NO_x and particulate matter will be realized with implementation of the proposed changes and therefore a significant emissions threshold requiring a major permit modification is not triggered.
- The changes are minor because the fundamental nature of the permitted WTP systems are unchanged (i.e. same generator function and the Standard Industrial Code (SIC) of the WTP are unchanged).
- All other WTP emission units associated with the PTF, HLW Facility, LAW Facility, Analytical Laboratory, Steam Plant, Type I Emergency Diesel Generator, and Glass Former Storage Facility have commenced construction and will not be modified.

2 Scope

Pre-application discussions with Ecology concluded that supplementing the existing *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT-ENV-01-007, Rev. 1 was appropriate for addressing the select emission unit changes. Emission units that remain unchanged and continue under construction will be highlighted where appropriate but emissions estimates and best available control technology (BACT) conclusions for these units will remain unchanged. To support Ecology review, the Application Supplement includes the following information:

- **Summary of Proposed Project -** Discussion of the original project and the proposed changes being pursued in the Application Supplement.
- **Review of Applicable Regulatory Requirements - S**ummary of applicable PSD requirements and discussion of emissions standards.
- **Process Description** - Summary of the existing WTP emission units and description of the new emergency turbine generators.
- **Emissions Estimates -** Summary of existing WTP maximum projected emissions and comparison to maximum projected emissions resulting from the replacement of Type II diesel generators with turbine generators, and the fire pump operating hour increase.
- **BACT** - Summary of BACT conclusions for all existing WTP emission units and new BACT analysis for NO_x and Particulate Matter emissions from the turbine generators.
- **Air Quality Analysis -** Discussion of existing WTP air quality analysis that assessed emissions of NO_x and PM_{10}. A new ambient air impact assessment focuses on EPAs new NAAQS for NO_2, SO_2, and $PM_{2.5}$. A screening evaluation of the projects impact to the nearest Class I Area is also included.

3 Review of Applicable Regulatory Requirements

The Federal Clean Air Act (CAA) requires major stationary sources of air pollution and major modifications to major stationary sources to obtain a PSD permit before starting construction. The CAA also requires facilities with existing Permits that undergo changes to evaluate whether a change triggers an action under PSD. To assist in the evaluation process, the Environmental Protection Agency (EPA) developed policy guidance that outlines criteria to consider when determining the level of review needed to process a change (EPA 1985 and EPA 1991). Review of the EPA guidance and pre-application discussions with Ecology determined that the proposed changes qualify as a Minor Permit Change since:

- The projected emissions do not exceed PSD significance thresholds.
- The changes are minor because the fundamental nature of the permitted systems are unchanged (i.e., the generator function and the Standard Industrial Code (SIC) of the WTP are unchanged).
- The location of the turbines will be identical to the Type II generators being replaced.
- The projected maximum NO_x and particulate matter emissions decrease.
-
- WTP construction has commenced and been on-going for several years.

As a result, the information provided in this Application Supplement is intended to provide Ecology the information necessary to support Amendment 3 of PSD-02-01.

3.1 New PSD Requirements

Since issuance of PSD-02-01, Amendment 2 in 2005, EPA has issued new National Ambient Air Quality Standards (NAAQS) for NO_2, SO_2, and $PM_{2.5.}$ These include a 1-hour NO_2, 1-hour SO_2 and a revised annual and new 24-hour standard for $PM_{2.5}$. Section 8 contains results of a complete modeling analysis comparing WTP emissions plus background concentrations to the of these new NAAQS.

In 2011, the EPA also finalized the PSD Greenhouse Gas Tailoring Rule which requires modifications to existing PSD sources to assess GHG emissions in accordance with the process identified in EPA guidance document *PSD and Title V Permitting Guidance for Greenhouse Gases* (EPA-457/B-11-001 dated March 2011) to determine whether GHG emissions must be incorporated into PSD. For modified sources who's revised PSD permit is issued after July 1, 2011, the Tailoring Rule invokes GHG requirements if the modification is a major modification and there is a net increase of 75,000 tons per year or more of carbon dioxide equivalents (CO_{2e}). Since the proposed changes do not trigger a major modification and Section 5 emissions estimates shows that the maximum projected CO_{2e} emissions at 1,432 tons per year, GHG permitting is not applicable to this change.Note that GHG emissions were all assumed to represent CO_2 since emission factors for other GHG constituents were not available in EPAs AP-42 for diesel fuel combustion sources and vendor emissions data did not assess GHG emissions.

3.2 Other Clean Air Act Regulations

As a new facility, the WTP also complies with the guidelines in WAC 173-400-110 and WAC 173-400-113 for sources in attainment or unclassifiable areas. These regulations are addressed in a separate *Non-Radioactive Air Emission Notice of Construction Permit Application for The River Protection Project - Waste Treatment Plan*, 24590-WTP-RPT-ENV-01-009 which was submitted to Ecology's Nuclear Waste Program (NWP). That application also met the requirements under WAC 173-460, *Controls for New Sources of Toxic Air Pollutants*, and WAC 173-400-110 for criteria pollutants less than significance thresholds. The WTP non-radionuclide Notice of Construction (NOC) application contained a BACT analysis for criteria and toxic air pollutants (T-BACT), a process description, and air quality impact analysis that compared dispersion modeling results of the toxic air pollutants to Washington State acceptable source impact levels (ASIL). The Nuclear Waste Program issued Approval Order DE02NWP-002 Amendments 1 through 4 to allow commencement of construction of the WTP.

In parallel with this PSD Application Supplement, a separate *Nonradioactive Air Emissions Notice of Construction Permit Application Supplement to DE02NWP-002*, 24590-WTP-RPT-ENV-12-002 will be submitted to Ecology's NWP to address the changes to DE02NWP-002. The Supplemental NOC contains similar information to the PSD Application Supplement as well as a Toxic Air Pollutant analysis.

Finally, WAC 173-401, *Operating Permit Regulation*, specifies the permitting requirements to be met for major sources, including the Hanford Site. Both PSD-02-01 and DE02NWP-002 are included in the Hanford Site Air Operating Permit (AOP) #00-05-006. In parallel with submittal of the PSD Application Supplement and Nonradioactive NOC Supplement, an Administrative Amendment Request will be submitted to Ecology's NWP to request incorporation of the amended PSD-02-01 and DE02NWP-002 into the Hanford Site AOP.

3.2.1 New Source Performance Standards

The CAA also requires certain categories of emissions sources to meet New Source Performance Standards (NSPS) under 40 CFR 60. The 40 CFR 60.4300 (Subpart KKKK) are applicable to the new emergency turbine generators because each units potential heat input is greater than 10 MMBtu per hour and the turbines will be constructed after calendar year 2005. The NSPS includes emissions criteria for both NO_x and SO_2.

Review of the criteria in the NSPS regulations confirms that the WTP turbines will be exempt from NO_x emissions limits because the units are classified as "emergency combustion turbines" since they will be used to produce power for critical networks and equipment when electric power from the local utility is interrupted.

Compliance with the SO_2 emissions limit will be maintained by limiting turbine fuel to ultra low sulfur diesel fuel with a sulfur content of 15 ppm or less. The NSPS requires liquid fuel sulfur content less than 500 ppm.

3.2.2 National Emissions Standards for Hazardous Air Pollutants

The WTP turbines will be subject to the CAA National Emissions Standards for Hazardous Air Pollutants for Stationary Combustion Turbines in 40 CFR 63.6080 (Subpart YYYY), because the WTP is located on the Hanford Site which is a major source of hazardous air pollutant emissions. Review of Subpart YYYY, section 63.6090(b)(i) establishes that the WTP turbines will only be subject to the initial notification requirements under 63.6145(d) within 120 days upon startup because the units are classified as emergency stationary combustion turbines. No other requirements under this standard apply. Ecology will be included in the initial startup notification to EPA.

4 Process Description and Planned Changes

4.1 WTP Process Overview

The WTP is being constructed to store and treat mixed waste from the Hanford Site Double Shell Tank system and will consist of three (3) main processing plants which include the PTF, LAW vitrification, and HLW vitrification. Tank waste will be received in the PTF where it will be separated into LAW and HLW feed. Waste will be immobilized in a glass matrix and poured into steel containers. Offgas generated by the pretreatment and vitrification processes will be treated in independent offgas treatment systems. Typical offgas streams include process vessel ventilation, melter offgas, and exhaust from fluidic transfer devices, such as reverse flow diverters and pulse jet mixers.

Building ventilation systems will also be incorporated into each of the processing plants and are designated as C2, C3, and C5 area emission units. Air from the treated building air ventilation systems will be vented to the atmosphere through dedicated flues.

The WTP will have an onsite analytical laboratory to support sampling and analysis activities. The offgases generated from sampling and analysis activities will be treated and vented to the atmosphere through three (3) dedicated emission units classified as C2, C3, and C5.

Support systems and utilities required for the WTP will be provided by the balance of facilities (BOF). The BOF facilities include steam plant boilers, Type I diesel generator, turbine generators, diesel engine driven fire pumps, and glass former storage facility.

Detailed process descriptions of each emissions unit are provided in the *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT-ENV-01-007, Rev. 1, Section 2 with the exception of the new turbine generators which are described in Section 4.9 below. Sections 4.2 through 4.7 are provided to summarize each WTP emission source currently being constructed and will not be changed.

4.2 Pretreatment Facility Emission Sources

The emission sources from pretreatment processes are plant building air ventilation, process vessel vents, reverse flow diverter (RFD) offgas, and pulse jet mixer (PJM) offgas. The plant building air is expected to contain particulates. The offgases from process vessels, RFD, and PJM will contain particulates, volatile organics, semi-volatile organics, and acid gases.

Insignificant amounts of NO_x gases are expected to be generated by radiolytic decomposition of nitric acid from the cesium nitric acid recovery process vessels. Descriptions of NO_x emissions and approved controls for the pretreatment plant are provided in Sections 5 and 6 of this document.

Insignificant amounts of particulates are expected to be emitted from the pretreatment building ventilation systems (less than 0.1 US ton). Particulate emissions from the pretreatment processes are produced from the entrained solids in the fluidic device exhausts and the process vessel vents.

4.3 LAW Building Ventilation and Process Offgas Emission Sources

The emission sources from the LAW vitrification processes are plant building air ventilation, process vessel vents, and LAW melter offgas. The offgases from process vessels will contain particulates, volatile and semi-volatile organics, and acid gases. The LAW melter offgas will contain particulates, radioactive gases, volatile and semi-volatile organics, acid gases, and NO_x gases.

NO_x emissions are expected to be produced from decomposition of nitrates and nitrites in the melter feed. As identified in Section 5, NO_x emissions from the LAW vitrification plant will be treated via selective catalytic reduction. Particulate emissions will be treated via single or dual stage HEPA filtration depending on the emission unit potential to emit radioactive particulates. Descriptions of NO_x and particulate emissions and selected BACT for the LAW vitrification plant are provided in sections 5 through 7 of this document.

Insignificant amounts of particulates are expected to be emitted from the building ventilation systems (less than 0.1 US ton per year). The building ventilation systems are described in Section 4.6. Particulate emissions from the LAW vitrification processes are the entrained particulates produced from the feed and the glass melt processes. Descriptions of the particulate emissions and selected controls are provided in sections 5 through 7 of this document.

4.4 HLW Building Ventilation and Process Offgas Emission Sources

The emission sources from the HLW vitrification processes include plant building air ventilation, process vessel vents, RFD/PJM exhausts, and HLW melter offgas. The plant building air is expected to contain particulates. The offgases from process vessels and RFD/PJM will contain particulates, volatile organics, and acid gas. The HLW melter offgas will contain particulates, radioactive gases, volatile organics, acid gases, and NO_x gases.

NO_x emissions are expected from the decomposition of nitrates and nitrites in the melter feed. As identified in Section 5, NO_x emissions from the HLW vitrification plant will be treated via selective catalytic reduction.

Insignificant amounts of particulates are expected to be emitted from the HLW building ventilation systems (less than 0.1 US ton per year). The building ventilation systems are described in Section 4.6 below.

Particulate emissions from the HLW vitrification processes are produced from the entrained particulates in the feed and will be treated through two (2) stages of HEPA filtration before release to the environment.

4.5 Analytical Laboratory

The WTP analytical laboratory emissions will consist of emissions from building air ventilation, hot cell ventilation, and sample analysis fume hood exhaust. Based on anticipated sampling and analytical activities, insignificant particulate emissions (less than 0.1 US ton per year) are expected. Inorganic emissions have been estimated from laboratory activities and documented in 24590-WTP-RPT-ENV-01-009, *Non-Radioactive Air Emissions Notice of Construction Permit Application for the River Protection Project-Waste Treatment Plant*. As a conservative assumption of particulate emissions, the laboratory inorganic emissions are assumed to be particulates. Based on this assumption, the particulate emissions from the laboratory are estimated to be 0.020 US tons per year. No NO_x emissions are expected from the laboratory (24590-WTP-RPT-ENV-01-009).

4.6 WTP Building Ventilation Systems

The building air supply for WTP process facilities (PTF, LAW vitrification, and HLW vitrification plants) and the analytical laboratory will be divided into four (4) numbered zones: C1 to C5 (C4 is not used). The higher number indicates greater radioactive contamination potential, and therefore requires a greater degree of control or restriction. A separate zoning system for the ventilation systems will be based on the system for classifying building areas for potential contamination. Zones classified as C5 will have the potential for the greatest contamination, and will include the pretreatment cells, melter cells, and glass pouring and cooling cells. All C5 zones will be operated remotely. Zones classified as C1 will be those areas that have no risk of contamination such as equipment rooms and offices. Based on expected operation activities, NO_x emissions are not expected from the building ventilation systems.

<u>C1 Ventilation System</u>

Typically, the C1 areas will consist of offices, workshops, control rooms, and equipment rooms. Emissions are not expected for the C1 areas.

<u>C2 Ventilation System</u>

Typically, the C2 areas will consist of non-process operating areas, access corridors, control and instrumentation, and electrical rooms. Filtered and tempered air will be supplied to these areas by the C2 supply system, and will be cascaded into adjacent C3 areas, or be exhausted by the C2 exhaust system. C2 areas can normally be accessed in street clothes and do not require personal protective equipment.

<u>C3 Ventilation System</u>

Typically, the C3 areas will consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Access from a C2 area to a C3 area will be through a C2/C3 sub-change room. Air will generally be drawn from C2 areas, and cascaded through the C3 areas, into C5 areas. In general, air cascaded into the C3 areas will be from adjacent C2/C3 sub-change rooms. In some areas, where higher flow may be required into C3 areas, C2/C3 boundary walls will be provided, with engineered transfer grilles equipped with backflow dampers.

C5 Ventilation System

In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow dampers and HEPA filters with sealed boundary penetrations .

The pretreatment plant C5 areas are designed with the cell or cave perimeter providing radiation shielding, as well as a confinement zone for ventilation purposes. C5 areas typically consist of a series of process cells where waste will be stored and treated. The PTF Facility hot cell will house major pumps and valves and other process equipment.

The C5 areas in the LAW and HLW vitrification plants will be composed of the following:

- Pour caves
- Transfer tunnel
- Buffer storage area
- C3/C5 drain tank room
- Process cells

Air will be cascaded into the C5 areas and be exhausted by the C5 exhaust system.

4.7 Balance of Facilities

The BOF will include support systems and utilities required for the waste treatment processes within the PTF, LAW vitrification and HLW vitrification plants, and the analytical laboratory. NO_x and particulate emissions are expected from the steam boilers, Type I diesel generator, turbine generators, diesel-driven fire water pumps and glass former storage facility.

4.7.1 Steam Boilers

There will be six (6) Cleaver-Brooks firetube steam boilers at the WTP Steam Plant. Each boiler is rated at 50.2 million British thermal units (BTU) per hour. The steam boilers will provide process steam and building heat to the PT, LAW vitrification and HLW vitrification plants, and the laboratory.

4.7.2 Fire Water Pumps

Two (2) 300 horsepower diesel engine-driven fire water pumps are used to support testing and maintenance of fire water systems, provide water for fire suppression in the event of a fire, and provide plant cooling water during loss of off-site power events. Diesel fuel day tanks will be located inside the fire water pumphouse. The fire water tanks will be located adjacent to the fire water pumphouse and are used to store the fire water, which is delivered to fire hydrants, standpipes, and fixed fire suppression systems.

4.7.3 Type I Diesel Generator

The 2,500 KW Type I diesel generator will provide electrical power to selected equipment and components within the BOF, LAW vitrification plant, and the HLW vitrification plants. The Type I diesel generator is a model year 2004 unit and is onsite awaiting final installation.

4.8 Glass Former Facility

A glass former facility is designed to receive, store, weigh, blend, and transport glass former materials to the LAW and HLW vitrification plants. The glass former facility building provides an enclosed facility that contains the bulk glass former material receipt and unloading area and an outdoor pad for storage silos and material handling equipment. The material receipt and unload area houses a bulk bag material storage area, the bulk bag handling equipment (bulk bag loaders and unloaders), a vacuum unloader, a transporter, the air handling equipment (compressors, air dryers, and receivers that support the glass former handling and pneumatic transport), and an operations office. The outdoor storage area will contain the material storage silos, weight hoppers, transporters, blending silos, and blended glass former transporters. The storage silos and blending silos will have baghouse filters to minimize emissions during loading and unloading. Transfer of the glass formers between the weigh hoppers, the blending silos, and the melter feed hoppers will occur through sealed, dense-phase pneumatic conveying.

4.9 Turbine Generators

The PSD-02-01, Amendment 2 permits operation of two (2) Type II diesel generators to provide emergency electrical power to selected equipment and components within the WTP facilities. The Type II generator design activity was terminated because WTP determined that turbine generator technology is a better solution from a technical standpoint and has the additional benefit of improving the cost-risk profile compared to diesel engine generator use, while continuing to assure a reliable source of emergency power for critical Nuclear Safety systems, structures, and components. Elements that support the change to turbine technology includes:

- Deletion of necessary diesel engine water cooling systems that include large air-cooled radiators and associated volcanic ash protection filtration systems.
- Improvement in efficiency and reduction in parasitic loads associated with three (3) otherwise-required 400 hp radiator cooling fans to support diesel engines.
- Turbine engine maintenance is eased, performed less frequently, and the systems typically involve approximately one-third the number of parts compared to diesel engine generators.
- Turbine technology results in a lower NO_x and particulate matter emissions alternative to equivalently sized diesel engine technology.

The Rolls-Royce Corporation has been selected to manufacture two (2) identical turbine generator Model 501-KB7s rated at approximately 3,800 kilowatt (KW) generator output each. Each turbine unit is a simple cycle design.

5 Emission Estimates

5.1 Original Project

Emission estimates for each source described in Sections 4.2 through 4.8 were provided in the *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT-ENV-01-007, Rev. 1 and remain unchanged. The emission unit specific and overall WTP emissions from the previous project are provided in Table 5-1. As previously discussed, the original project exceeded the PSD significance thresholds for both NO_x and PM_{10}.

5.2 Proposed Project

The proposed project decreases overall WTP emissions of NOx and particulate matter through substitution of turbine generators for the approved Type II diesel generators, and increases emission from the added fire water pump operating hours. The Table 5-2 provides an overview of the resulting emissions and illustrates that the proposed project will reduce overall maximum projected WTP emissions of NO_x by approximately 3 tons per year and PM_{10} emissions by less than 1 ton. The Table 5-2 also demonstrates that slight emissions increases of SOx, CO, and VOC pollutants result from the proposed project but are well below PSD significance levels. Since $PM_{2.5}$ is now a regulated pollutant, emissions from the turbines and fire pumps are included and show maximum projected emissions at 0.05 tons per year which is below PSD thresholds.

In 2011, the EPA also finalized the PSD Greenhouse Gas Tailoring Rule which requires modifications to existing PSD sources to assess GHG emissions in accordance with the process identified in EPA guidance document *PSD and Title V Permitting Guidance for Greenhouse Gases* (EPA-457/B-11-001 dated March 2011) to determine whether GHG emissions must be incorporated into PSD. For modified sources who's revised PSD permit is issued after July 1, 2011, the Tailoring Rule invokes GHG requirements if the modification is a major modification and there is a net increase of 75,000 tons per year or more of carbon dioxide equivalents (CO_{2e}). Since the proposed changes do not trigger a major modification and Table 5-2 demonstrates that the maximum projected CO_{2e} emissions at 1,432 tons per year, GHG permitting is not applicable to this change. Note that GHG emissions were all assumed to represent CO_2 since emission factors for other GHG constituents were not available in EPAs AP-42 for diesel fuel combustion sources and vendor emissions data did not assess GHG emissions.

The methodology used to estimate maximum projected turbine emissions is detailed in Appendix A. The estimated maximum projected turbine emissions of NO_x, CO, SO_2, and VOCs are based on limiting planned operation to 164 hours per year and using Rolls-Royce emissions factors. For emissions of total PM, PM_{10}, $PM_{2.5}$, and CO_2, EPAs AP-42 (EPA 2000) emission factors, turbine maximum fuel consumption rates, and planned operating hours were used since vendor emissions data is not available for these pollutants.

The previous Type II generator criteria pollutant emission rates are also provided for comparison. Results of the comparison show that Type II generators NO_x emissions totaled approximately 15 tons per year while emissions from the turbines are approximately 11 tons per year. Accounting for the slight increase in fire water pump NO_x emissions, summation of all WTP NO_x sources shows a 3 ton per year reduction.

Emissions of all forms of particulate matter resulting from the change to turbines showed a small reduction from previous Type II generator technology. Factoring in the slight increase from the fire water pump engine operating hour increase, overall WTP emissions of PM have been reduced by less than 1 ton per year.

Table 5-1 Existing Annual WTP Controlled PSD-Regulated Criteria Pollutant Emission Estimates (US tons per year) [a]

Criteria Pollutant	Pretreatment Facilities	LAW Vitrification Facility	HLW Vitrification Facility	Boiler Plant	Diesel Generators [e]	Miscellaneous Facility Sources [b]	Total Emissions	PSD Significance Limits
CO	7.94E-21	2.20	0.36	65.6	2.4	0.02	70.58	100
NO_x	0.44	36.7	8.5	84.3	20.4	0.4	150.37	40
SO_2	1.09E-21	3.68	4.84	2.9[d]	0.03 [d]	6.0E-04 [d]	11.44	40
PM_{10} [b, c]	2.03	1.57	1.18	18.7	0.7	0.06	24.24	15
VOCs (as total volatile and semi-volatile organics)	3.84	0.47	0.38	28.1	0.8	0.01	33.60	40
Pb	1.03E-09	2.65E-9	1.99E-11	8.43E-03	4.7E-03	3.99E-04	0.01	0.6

Notes:

a See *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT- ENV-01-007, Rev. 1, Appendix B for detailed emissions calculations and assumptions.

b Miscellaneous BOF source emissions represent the emissions from the diesel fire water pumps and particulate emissions from the glass former facility.

c All particulate matter was assumed to be PM_{10}.

d Ultra-low sulfur fuel (30 ppm, 0.003%) was used for estimating emissions for the steam boilers, generators, and fire water pumps.

e Type I diesel generators emit 5.4 tons NOx and Type II generators emit 15 tons/yr for a total of 20.4 tons/yr

Table 5-2 Proposed Annual WTP Controlled PSD-Regulated Criteria Pollutant Emissions (US tons per year)

Criteria Pollutant	[a] Pretreatment Facilities	[a] LAW Vitrification Facility	[a] HLW Vitrification Facility	[a] Steam Plant Boilers	[b] Type I Diesel Generator	[b] Diesel Turbine Generators	[b] Fire Pumps	Total WTP Emissions	PSD Emissions Threshold
CO	7.94E-21	2.20	0.36	65.6	0.64	6.33	0.03	75.2	100
NO_x	0.44	36.7	8.5	84.3	5.4	11.4	0.78	**147.5**	40
SO_2	1.09E-21	3.68	4.84	2.9 [c]	0.01 [c]	0.04 [c]	6.0E-04 [c]	11.46	40
PM_{10}	2.03	1.57	1.18	18.7	0.18	0.1	0.03 [d]	**23.77**	15
$PM_{2.5}$	NA	NA	NA	NA	NA	0.04	0.02	0.05	10
VOCs (as total volatile and semi-volatile organics)	3.84	0.47	0.38	28.1	0.21	1.80	0.03	34.83	40
GHG	NA	NA	NA	NA	NA	1352	79.35	1432	75,000
Pb	1.03E-09	2.65E-9	1.99E-11	8.43E-03	1.25E-03	1.20E-04	0	0.01	0.6

Notes:

a Based on *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT- ENV-01-007, Rev. 1, Appendix B

b Based on Appendix A Calculation

c Ultra-low sulfur fuel (30 ppm) was used for estimating emissions for the steam boilers and type I diesel generator. Turbine and fire water pump emissions were based on 15 ppm sulfur.

d Glass Former Facility particulate emissions are included in estimate

e PM2.5 and GHG emission rates are only provided for the turbines and fire pumps since these are the only emission sources proposed for change and therefore subject to the new standards.

6 Best Available Control Technology for Emissions of NOx

6.1 Selected BACT for Existing WTP Emission Units

The *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT- ENV-01-007, Rev. 1, Section 4 contains a detailed BACT Analysis for each NOx emissions source undergoing construction at WTP. The analysis reviewed control technology options, eliminated technically infeasible options, ranked remaining options and selected the proposed control. Ecology subsequently approved the BACT via the original PSD-02-01. Table 6-1 identifies the NOx BACT for each WTP emission source.

Table 6-1 Summary of Selected BACT for NO_x

Source	Control Technology	Approximate Control Efficiency
Pretreatment	Operating practices to minimize NO_x emissions, caustic scrubber	Not applicable
LAW melter offgas	Selective Catalytic Reduction (SCR)	95 %
HLW melter offgas	SCR	95 %
Steam boilers	• Low NO_x burners • Steam atomization • Limit annual ULSD fuel consumption to 13,400,000 gallons per year	70%
Type I and II Backup generators and fire water pump engines	• Good combustion engineering practices • Limited operating hours	Not applicable

The BACT conclusions for the above WTP sources will remain unchanged since changes are not proposed and each emission unit has either commenced construction or initiated operation. As previously discussed, Type II generators technology is being eliminated from WTP design. The focus of the BACT discussion in this Application Supplement is to evaluate NO_x control options for the emergency turbine generators.

6.2 NO_x BACT for Turbine Generators

As discussed in Section 4.9, two (2) Rolls-Royce turbine generators rated at approximately 3,800 KW will replace the Type II diesel generators for backup power production. As a new source, the following sections provide an evaluation and selection of NO_x control for turbine generator emissions.

6.2.1 BACT Review Methodology

As a new source, an analysis has been conducted to demonstrate that BACT will be applied to the turbine generators. The requirement to conduct a BACT analysis is set forth in Section 165(a)(4) of the CAA, and in federal regulations in 40 CFR 52.21(j), which is defined as:

> ...an emission limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source of modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61 (EPA 1990b).

The EPA guidance identifies a five step process for performing a BACT Analysis. The steps include:

1. Identification of control technologies
2. Elimination of Technically Infeasible Control Options
3. Rank Technically Feasible Control Options
4. Evaluation of Most Effective Control Options
5. Selection of BACT

EPA's BACT determination guidance also organizes the potential control technologies to be considered into three groups:

- Lower-emitting processes or practices (that is, the use of materials or processes that prevent or minimize the production of emissions and, therefore, result in lower emission rates)
- Add-on control equipment (that is, the use of equipment that captures, controls, and reduces emissions after they are produced)
- Combinations of lower-emitting processes and add-on control equipment (EPA 1990b)

The turbine engine BACT analysis included a review of EPAs *Compilation of Air Pollutant Emissions Factors, AP-42, fifth edition, Volume I, Chapter 3.1* to identify possible control technologies available to reduce turbine emissions as well as a search of EPA's RACT/BACT/LAER clearinghouse to determine what other similar permitted units are employing as BACT and to ensure a consistent approach with other similar sources.

6.2.2 Identification of NO_x Control Options

There are several emission controls to consider for reducing turbine NO_x emissions. These include:

- Operational controls practices
- Wet controls using water injection to reduce combustion temperatures for NO_x control

- Dry controls using advanced combustor design to suppress NO_x formation
- Post-combustion catalytic control to selectively reduce NO_x
- Other catalytic systems

6.2.2.1 Water injection Control

Water or steam injection is a technology that has been demonstrated to effectively suppress NO_X emissions from gas turbines. The effect of steam and water injection is to increase the thermal mass by dilution and thereby reduce peak temperatures in the flame zone. With water injection, there is an additional benefit of absorbing the latent heat of vaporization from the flame zone. Water or steam is typically injected at a water-to-fuel weight ratio of less than one.

Depending on the initial NO_X levels, such rates of injection may reduce NO_X by 60 percent or higher. Water or steam injection is usually accompanied by an efficiency penalty (typically 2 to 3 percent) but an increase in power output (typically 5 to 6 percent). The increased power output results from the increased mass flow required to maintain turbine inlet temperature at manufacturer's specifications. Both CO and VOC emissions are increased by water injection, with the level of CO and VOC increases dependent on the amount of water injection.

6.2.2.2 Dry Controls

Since thermal NO_X is a function of both temperature (exponentially) and time (linearly), the basis of dry controls are to either lower the combustor temperature using lean mixtures of air and/or fuel staging, or decrease the residence time of the combustor. A combination of methods may be used to reduce NO_x emissions such as lean combustion and staged combustion (two stage lean/lean combustion or two stage rich/lean combustion).

Lean combustion involves increasing the air-to-fuel ratio of the mixture so that the peak and average temperatures within the combustor less than that of the stoichiometric mixture, thus suppressing thermal NO_x formation. Introducing excess air not only creates a leaner mixture but it also can reduce residence time at peak temperatures.

Two-stage lean/lean combustors are essentially fuel-staged, premixed combustors in which each stage burns lean. The two-stage lean/lean combustor allows the turbine to operate with an extremely lean mixture while ensuring a stable flame. A small stoichiometric pilot flame ignites the premixed gas and provides flame stability. The NO_x emissions associated with the high temperature pilot flame are insignificant. Low NO_x emission levels are achieved by this combustor design through cooler flame temperatures associated with lean combustion and avoidance of localized "hot spots" by premixing the fuel and air.

Two stage rich/lean combustors are essentially air-staged, premixed combustors in which the primary zone is operated fuel rich and the secondary zone is operated fuel lean. The rich mixture produces lower temperatures (compared to stoichiometric) and higher concentrations of CO and H_2, because of incomplete combustion. The rich mixture also decreases the amount of oxygen available for NO_x generation. Before entering the secondary zone, the exhaust of the primary zone is quenched (to extinguish the flame) by large amounts of air and a lean mixture is created. The lean mixture is pre-ignited and the combustion completed in the secondary zone. NO_x formation in the second stage are minimized through combustion in a fuel lean, lower temperature environment. Staged combustion is identified through a variety of names, including Dry-Low NO_x (DLN), Dry-Low Emissions (DLE), or $SoLoNO_x$.

6.2.2.3 Catalytic Reduction Systems

Selective catalytic reduction (SCR) systems selectively reduce NO_x emissions by injecting ammonium (NH_3) into the exhaust gas stream upstream of a catalyst. Nitrogen oxides, NH_3, and O_2 react on the surface of the catalyst to form N_2 and H_2O. The exhaust gas must contain a minimum amount of O_2 and be within a particular temperature range (typically 450°F to 850°F) in order for the SCR system to operate properly.

The temperature range is dictated by the catalyst material which is typically made from noble metals, including base metal oxides such as vanadium and titanium, or zeolite-based material. The removal efficiency of an SCR system in good working order is typically from 65 to 90 percent. Exhaust gas temperatures greater than the upper limit (850° F) cause NO_x and NH_3 to pass through the catalyst unreacted. Ammonia emissions, called NH_3 slip, may be a consideration when specifying an SCR system.

Ammonia, either in the form of liquid anhydrous ammonia, or aqueous ammonia hydroxide is stored on site and injected into the exhaust stream upstream of the catalyst. Although an SCR system can operate alone, it is typically used in conjunction with water-steam injection systems or lean-premix system to reduce NO_x emissions to their lowest levels (less than 10 ppm at 15 percent oxygen for SCR and wet injection systems). The SCR system for landfill or digester gas-fired turbines requires a substantial fuel gas pretreatment to remove trace contaminants that can poison the catalyst. Therefore, SCR and other catalytic treatments may be inappropriate control technologies for landfill or digester gas-fired turbines.

The catalyst and catalyst housing used in SCR systems tend to be very large and dense (in terms of surface area to volume ratio) because of the high exhaust flow rates and long residence times required for NO_x, O_2, and NH_3, to react on the catalyst. Most catalysts are configured in a parallel-plate, "honeycomb" design to maximize the surface area-to-volume ratio of the catalyst. Some SCR installations incorporate CO catalytic oxidation modules along with the NO_x reduction catalyst for simultaneous CO/NO_x control.

6.2.2.4 Other Technologies

New catalytic reduction technologies have been developed and are currently being commercially demonstrated for gas turbines. Such technologies include, but are not limited to, the SCONOX and the XONON systems, both of which are designed to reduce NO_x and CO emissions. The SCONOX system is applicable to natural gas fired gas turbines. It is based on a unique integration of catalytic oxidation and absorption technology. CO and NO are catalytically oxidized to CO_2 and NO_2. The NO_2 molecules are subsequently absorbed on the treated surface of the SCONOX catalyst. The SCONOX system does not require the use of ammonia, eliminating the potential of ammonia slip conditions evident in existing SCR systems.

The XONON system is applicable to diffusion and lean-premix combustors and is currently being demonstrated with the assistance of leading gas turbine manufacturers. The system utilizes a flameless combustion system where fuel and air reacts on a catalyst surface, preventing the formation of NO_x while achieving low CO and unburned hydrocarbon emission levels. The overall combustion process consists of the partial combustion of the fuel in the catalyst module followed by completion of the combustion downstream of the catalyst. The partial combustion within the catalyst produces no NO_x, and the combustion downstream of the catalyst occurs in a flameless homogeneous reaction that produces almost no NO_x. The system is totally contained within the combustor of the gas turbine and is not a process for clean-up of the turbine exhaust. Note that this technology has not been fully demonstrated as of the drafting of this section. The catalyst manufacturer claims that gas turbines equipped with the XONON catalyst emit NO_x levels below 3 ppm and CO and unburned hydrocarbons levels below 10 ppm. Emissions data from gas turbines equipped with a XONON catalyst were not available as of the drafting of this section.

6.2.2.5 Operational Controls

Limiting a turbines operational hours reduces NO_x emissions since annual emissions mass is a function of operating durations. Units that serve as emergency power sources have limited operating time for testing and maintenance and results in much lower emissions than a source operating continuously. In addition, following good combustion engineering practices such as adherence to manufacturer's specifications for operation, maintenance, and combustion control assist in reducing emissions.

6.2.3 Elimination of Infeasible Technologies

The feasibility of NO_x abatement technologies for application on the WTP turbine generators is based on whether a technology is feasible for use on an ASME NQA-1 emergency turbine generator needed to support critical Nuclear Safety systems to ensure starting reliability. Although many of the control technologies may be technically feasible for non-emergency turbines, their use on a simple cycle emergency turbine generator operating limited hours each year would not be feasible from a cost per ton removed perspective considering that each turbine NO_x emissions are approximately 5.5 tons per year.

The following paragraphs discuss each technologies feasibility.

Steam Injection Control

Steam injection control was eliminated due to anticipated costs associated with installing ASME NQA-1 steam injection system to support the ASME NQA-1 turbine engines. From a Nuclear Safety standpoint, the turbine support systems must equal the turbines pedigree to ensure starting reliability needed to meet Safety Class criteria. Safety Class criteria is assigned to WTP systems, structures, and components which are intended to limit radioactive hazardous material exposure to members of the public.

Dry Controls

Dry control technologies were eliminated from consideration based on discussions with the turbine vendor who indicated that dry combustion controls are only available for gaseous fuel turbines. Since the WTP turbine generators will be fired solely on liquid fuel, this technology was eliminated from consideration.

Catalytic Reduction and Other Post Combustion Catalytic Technologies

Post combustion catalytic reduction technologies were eliminated due to anticipated costs associated with installing an ASME NQA-1 system to support the ASME NQA-1 turbine engines. From a Nuclear Safety standpoint, the turbine support systems must equal the turbines pedigree to ensure starting reliability needed to meet Safety Class criteria.

6.2.4 Remaining Control Technologies and Selection of Proposed BACT

The remaining control technologies include operational controls such as limiting hours of operation and maintaining good combustion engineering practices. Operation of each emergency turbine will be limited to 164 hours per year to account for bi-weekly 6-hour testing and an assumed 8-hour loss of off-site power event. In addition, good combustion engineering practices will be followed, which includes adherence to the Rolls-Royce specifications for operation, maintenance, and combustion control.

Specified combustion feed ratios (including the fuel-to-air ratio), monitoring, and startup/shutdown procedures will be followed to maximize combustion efficiency and minimize discharge to the atmosphere.

7 BACT for Emissions of Particulate Matter

The existing *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT- ENV-01-007, Rev. 1, Section 5 contains a detailed BACT Analysis for PM_{10} emissions from each WTP PSD emission unit. The analysis reviewed control technology options, eliminated technically infeasible options, ranked remaining options and selected the proposed control. Ecology subsequently approved the selected technology via the original PSD-02-01. Table 7-1 identifies the selected BACT for each WTP PM emission source.

Table 7-1 Summary of Selected BACT for PM_{10}

Source	**Control Technology**	**Approximate Control Efficiency**
Pretreatment	HEPA Filters	99.95%
LAW melter offgas	HEPA Filters	99.95%
HLW melter offgas	HEPA Filters	99.95%
Steam boilers	• Good combustion engineering practices • Particulate emission limit of 0.020 lb/mm Btu	Not applicable
Type I and II Backup generators and fire water pump engines	• Good combustion engineering practices • Limited testing hours	Not applicable
Glass Former Facility	Baghouse or Filters	99.9%

The BACT conclusions for the above WTP sources, except for the Type II generators which are being removed from design, will remain unchanged since changes are not proposed and each emission unit has either commenced construction or initiated operation. The focus of the BACT discussion in this Application Supplement is to evaluate PM_{10} control options for the emergency turbine generators.

7.1 Particulate Matter BACT for Turbine Generators

As discussed in Section 6.2, two (2) Rolls-Royce turbine generators rated at 3,800 KW will replace the Type II diesel generators for backup power production. Emissions analysis provided in Section 5 shows the emission rate at maximum load for two turbines results in approximately 0.1 tons per year total PM while combusting ultra low sulfur diesel fuel with a sulfur content of 15 ppm (0.0015 wt % sulfur). Particulate emissions from diesel turbines primarily result from carryover of noncombustible trace constituents and sulfur content in the fuel.

7.1.1 Identification of Control Options

A review of potential controls for consideration as BACT was performed using EPA's RACT/BACT/LAER clearinghouse and AP-42, Section 3.1-4. Particulate matter control approaches for consideration include:

- Combustion control options
- Post-combustion control technologies

Combustion Processes

The formation of PM within the turbine generators can be limited through the use of gaseous fuels or liquid fuel with ultra low sulfur content. In addition, following good combustion engineering practices can limit emissions, which include adhering to the manufacturer specifications for operation, maintenance, and combustion control.

Post-Combustion Reduction Technologies

Results of the review showed that all categories of turbines are controlling particulate emissions through combustion of clean fuels such as natural gas or low sulfur distillate oil. Post-combustion reduction control technologies for PM emissions are not being used.

7.1.2 Technical Feasibility Considerations

Based on review of EPA's RACT/BACT/LAER clearinghouse for all fuel and size categories of combustion turbines, post-combustion PM control technologies are not considered feasible considering that no turbines utilized post combustion BACT devices. Post control options were also eliminated because the WTP turbine generators emissions are estimated at 0.1 tons per year which is considered insignificant. As discussed in Section 6.2.3, had a post combustion control been available, its feasibility would have been questioned due to anticipated costs associated with installing ASME NQA-1 components to support the ASME NQA-1 turbine engines.

7.1.3 Selection of Proposed BACT for Turbine Generators

The selected BACT for controlling PM emissions from the turbine generators will include combusting only ULSD fuel with a sulfur content of 0.0015 wt% (15 ppm) or less, and limiting the hours of operation to 164 per year each. Following these combustion practices will limit total emissions of PM, which includes both PM_{10} and $PM_{2.5}$ to an insignificant 0.1 tons per year.

Finally, good combustion engineering practices will be followed, which includes adhering to the Rolls-Royce specifications for operation, maintenance, and combustion control. Specified combustion feed ratios (including the fuel-to-air ratio), monitoring, and startup/shutdown procedures will be followed to maximize combustion efficiency and minimize discharge to the atmosphere.

8 Air Quality Impact Analysis

8.1 Existing Project

The *Prevention of Significant Deterioration Application for the Hanford Tank Waste Treatment and Immobilization Plant*, 24590-WTP-RPT- ENV-01-007, Rev. 1, Section 6 provided a detailed air quality analysis of NO_x and PM_{10} since PSD significance levels were exceeded for both pollutants. The analysis utilized emissions data and onsite meteorological data as inputs into the *Industrial Source Complex - Short Term* (ISCST3) air dispersion model, version 02035, to determine compliance with NAAQS. The ISCST3 was used to determine the maximum annual and 24-hour average ground-level air concentrations attributable to the WTP.

Potential emission sources of NO_x and PM_{10} included an offgas emission unit for each of the three (3) WTP process plants (PTF, LAW vitrification, and HLW vitrification plants), a stack for boiler emissions, and a stack for the Type I, Type II, and fire water pump diesel engine combustion equipment. Building ventilation and laboratory stacks will have insignificant emissions of NO_x or PM_{10}, and therefore were not considered in the modeling analysis.

The highest annual average impact at an offsite receptor or public access point was calculated to be 0.61 $\mu g/m^3$ for NO_2 and 0.11 $\mu g/m^3$ for PM_{10}, based on the Hanford meteorological data set for the worst-case year (1997). The location of the maximum concentrations is the elevated terrain to the east of the WTP facility, across the Columbia River in the Ringold and White Bluffs area. Because the results of the modeling analyses showed that the maximum average annual NO_2 and PM_{10} concentrations at an offsite receptor or public access point are below the 1.0 $\mu g/m^3$ threshold level, there will be no significant impact from the WTP source.

The highest 24-hour impact at an offsite receptor or public access point was calculated to be 1.93 $\mu g/m^3$ for PM_{10}, based on the Hanford meteorological data set for the worst-case year (1997). Because the results of the modeling analyses showed that the maximum 24-hour average PM_{10} concentrations at an offsite receptor or public access point is below the 5.0 $\mu g/m^3$ threshold level, there will be no significant impact from the WTP.

Table 8-1 Summary of Maximum Modeled Impacts and Significance Determinations

National Ambient Air	**NO_x Annual Average Concentration ($\mu g/m^3$)**	**PM_{10} Annual Average Concentration ($\mu g/m^3$)**	**PM_{10} 24-Hour Average Concentration ($\mu g/m^3$)**
Maximum predicted concentration from proposed project	0.61	0.11	1.93
Significance threshold	1.0	1.0	5.0
Significance determination	No	No	No

The nearest Class I Areas are located at extended distances from the WTP, which include: Alpine Lakes Wilderness Area (137 km to the northwest); Goat Rocks Wilderness Area (142 km to the west); Mt. Adams Wilderness Area (153 km to the west-southwest); Mt. Rainier National Park (153 km to the west-northwest); and the Eagle Cap Wilderness Area (185 km to the southeast). Because there have been no modeled concentrations above 1.0 $\mu g/m^3$ on the Hanford site, the impacts from the WTP at these Class I Areas are well below the Class I Area increment standard of 1.0 $\mu g/m^3$. The Class I Area with the highest average annual concentration for NO_x and PM_{10} emissions is the Eagle Cap Wilderness Area. The predicted impact for NO_x is 0.00505$\mu g/m^3$, and the predicted impact for PM_{10} is 0.00080 $\mu g/m^3$ on an annual average and 0.058 $\mu g/m^3$ on a 24-hour average. The highest impacts are predicted to be at the Eagle Cap Wilderness Area because the dominant west-northwest and northwest winds preferentially transport the emissions to the southeast, in the direction of that wilderness area.

Table 8-2 Summary of Annual Average NO_x Concentrations at Class I Wilderness Areas Surrounding the WTP

Class I Area	NO_x Annual Average Concentration ($\mu g/m^3$)	PM_{10} Annual Average Concentration ($\mu g/m^3$)	PM_{10} 24-Hour Average Concentration ($\mu g/m^3$)
Alpine Lakes Wilderness Area	0.00250	0.00041	0.049
Goat Rocks Wilderness Area	0.00194	0.00030	0.053
Mt. Adams Wilderness Area	0.00175	0.00027	0.046
Mt. Rainier National Park	0.00316	0.00047	0.046
Eagle Cap Wilderness Area	0.00505	0.00080	0.058

8.2 Proposed Project

An ambient air analysis was performed to assess the proposed projects impacts to EPAs new National Ambient Air Quality Standards (NAAQS) for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter 2.5 microns or less ($PM_{2.5}$). The primary concern for new sources or modifications of existing sources located in an attainment area is to determine whether emissions exceed a NAAQS or Class I wilderness area increment.

Dispersion Model Information

The dispersion modeling analysis used BEE-Line Software's BEEST Version 9.93 to assess WTP impacts to the new NAAQS. The BEEST program is a Windows based user interface to the Environmental Protection Agency's approved AERMOD air dispersion model. BEEST Version 9.93 includes AERMOD version 11353, AERMET version 11059, AERMAP version 11103, and BPIP-Prime version 04274.

AERMOD utilizes individual emission point release characteristics, source emission rates, surface and upper air meteorological data, terrain data, and receptor data to determine maximum annual, 24-hr, and 1-hr concentrations affecting offsite receptors.

New NAAQS

The EPA recently established new NAAQS for the following:

- 1-hour NO_2 NAAQS of 100 ppb (188 µg/m^3)
- 1-hour SO_2 NAAQS of 75 ppb (196 µg/m^3)
- EPA also revised the $PM_{2.5}$ NAAQS to establish a new 24-hr level of 35 µg/m^3 and retained the existing $PM_{2.5}$ annual level of 15 µg/m^3.

The total impact from the proposed project plus background values provided by Ecology were summed to evaluate impacts to NAAQS. Results of the analysis are provided in Tables 8-8 through 8-11 below.

Emission Sources

Although this permit action only proposes change to several WTP sources, the ambient air impact assessment includes emission rates from all WTP sources. The potential emissions sources of NO_2, SO_2, and $PM_{2.5}$ include the offgas emission units for each of the WTP process facilities (Pretreatment, LAW vitrification, and HLW vitrification), a stack for boiler emissions, a stack for type I diesel generator emissions, a stack for turbine generator emissions, and a stack for diesel engine driven fire pump emissions. Building ventilation and laboratory stacks emit insignificant amounts of these pollutants and therefore were not considered in the modeling analysis.

Release Characteristics

Stack characteristics were modeled as point sources with release parameters corresponding to design specifications or manufacturer data. A summary of the release parameters for the modeled sources is provided in Table 8-3 below.

Table 8-3: WTP STACK RELEASE PARAMETERS

Stack Parameter	PT	LAW	HLW	Boilers	Standby Generator	Turbines	Fire Pumps
Stack height (ft)	200	200	200	35	15	57	10
Stack Temperature (^oF)	100	150	275	425	959	989	829
Exit Diameter (ft)	2	1.5	1	1	1	3	0.5
Exit Velocity (ft/s)	21.22	67.43	45.79	39.53	205	168	0.001
Exit Flowrate (acfm)	4000	7150	2158	1862	21824	71251	0.011

The basis for the stack parameters included:

- Process emission units - CCN 226807, *Process Engineering Stack Effluent Conditions*
- Boiler - 24590-WTP-HAC-50-00006, sheet 34 *Emission Estimates for the Prevention of Significant Deterioration Permit Application*
- Turbines - 24590-CD-POA-MUTC-00001-02-00001, rev. C, *Rolls Royce Industrial Engine Performance & Emissions*

- Turbines - 24590-BOF-P1-89-00016, Rev.0, *Balance of Facilities ETG Plant Sections*
- Standby Diesel Generator - 24590-WTP-SDDR-MS-07-00060, *SDG-Emissions Testing Parameter Corrections*
- Fire Pumps - 24590-WTP-HAC-50-00006, Sheet 37, *Emission Estimates for the Prevention of Significant Deterioration Permit Application*

Modeled Emission Rates

Annual emission estimates for all emission sources, reported as US tons per year, annualized over a continuous operating schedule of 8,760 hours per year were modeled to predict annual concentrations using a full year of meteorological data.

Note that PM_{10} emission estimates were conservatively assumed to represent $PM_{2.5}$ emission rates for the process facility emission units, steam boilers, and type 1 standby diesel generator because $PM_{2.5}$ emission rates had not been calculated during previous permitting efforts. Estimated $PM_{2.5}$ emission rates were used for modeling the turbine generator and diesel engine fire pumps since these were calculated in the current permitting effort.

Maximum 1-hr and daily emission rates were calculated for comparison with the 1-hr NO_2, 1-hr SO_2, and 24-hour $PM_{2.5}$ NAAQS. Because the pretreatment, LAW vitrification, and HLW vitrification, and boiler emission units may operate 8760 hours per year, the maximum daily emission rate is the same as the average daily emission rate. Therefore, emission rates for these releases did not change for the 1-hr NO_2, 1-hr SO_2, and $PM_{2.5}$ 24-hour analysis.

Since the type I diesel generator, turbine generators, and diesel engine fire pumps will operate limited hours per year, their maximum hourly and hourly emission rates were calculated based on the emission rates identified in Appendix A, Tables 1 and 2 rather than extrapolated from annual emissions because that would have underestimated actual potential short term emission rates.

Table 8-4 through 8-6 below shows actual emission estimates (US tons per year) and annualized average emission rates (gram per second), as modeled, for comparison to each NAAQS. Detailed presentation of emission rates are provided in Appendix A.

Table 8-4 NO_x Emission Estimates and Modeled 1-hr Emission Rates

Emission Unit	Annual NOx Emission Estimates (tons/yr)	1-hr Nox Emission Rate (g/s)
LAW Off Gas	36.7	1.06
HLW Offgas	8.5	0.24

PT Off-Gass	0.4	0.01
Boilers	84.3	2.43
[1]Standby Generator	5.4	8.23
[1]Turbine Generators	11.4	17.59
[1]Fire Pumps	0.8	0.85
[1] Since the type I diesel generator, turbine generators, and diesel engine fire pumps will operate limited hours per year, their maximum hourly and hourly emission rates were calculated based on the emission rates identified in Appendix A, Tables 1 and 2 rather than extrapolated from annual emissions because that would have underestimated actual potential short term emission rates.		

Table 8-5 $PM_{2.5}$ Emission Estimates and Modeled Annual and 24-hr Emission Rates

Emission Unit	Annual Emission Estimates (tons/yr)	Annualized Average Emission Rate as Modeled (g/s)	24-hr Average Emission Rate as Modeled (g/s)
LAW Off Gas	1.57	0.05	0.05
HLW Offgas	1.18	0.03	0.03
PT Off-Gass	2.03	0.06	0.06
Boilers	18.7	0.54	0.54
[1]Standby Generator	0.18	0.01	0.27
[1]Turbine Generators	0.04	0.001	0.06
[1]Fire Pumps	0.01	0.0003	0.01
[1] Since the type I diesel generator, turbine generators, and diesel engine fire pumps will operate limited hours per year, their maximum hourly and hourly emission rates were calculated based on the emission rates identified in Appendix A, Tables 1 and 2 rather than extrapolated from annual emissions because that would have underestimated actual potential short term emission rates.			

Table 8-6: SO_2 Emission Estimates and 1-hr Emission Rates

Emission Unit	Annual Emission Estimates (tons/yr)	1-hr Emission Rate (g/s)
LAW Off Gas	3.68	0.11
HLW Offgas	4.84	0.14
PT Off-Gass	0.001	0.00
Boilers	2.9	0.08
Standby Generator	**0.01**	**0.01**
Turbine Generators	**0.04**	**0.06**
Fire Pumps	**0.001**	**0.001**
[1] Since the type I diesel generator, turbine generators, and diesel engine fire pumps will operate limited hours per year, their maximum hourly and hourly emission rates were calculated based on the emission rates identified in Appendix A, Tables 1 and 2 rather than extrapolated from annual emissions because that would have underestimated actual potential short term emission rates.		

Building Downwash

The building profile input program (BPIP-Prime) was used to determine dominant structures for building downwash calculations made in AERMOD for point sources. Direction-specific building heights and widths of the dominant downwash structures have been included in the AERMOD input file directly from the BPIP-Prime results.

Modeling Source Groups

The AERMOD model allows users to group contributions from all sources together for comparison to an NAAQS. Potential emission sources at the WTP were modeled as a single source group in AERMOD to determine impacts based on combined emissions. Thus, the model calculates a total impact at a specified receptor by summing the individual impacts contributed by each source for each averaging period included in the modeling analysis. Individual source groups were also shown on the model output to demonstrate each WTP source contribution to the NAAQS.

AERMET Meteorological Data

The AERMET pre-processing program was run with a sequential hourly meteorological data set. Calendar year 2003 was randomly selected for the modeling effort since comparison to other years showed insignificant changes in the overall modeling results.

Surface air data such as wind direction, wind speed, temperature, and precipitation have been obtained from Station 21 of the Hanford Meteorological Monitoring Network, which is located in the 200 East Area within 1 mile of the location of the WTP. The surface data is read into the model in CD-144 format.

Upper air data used to calculate mixing heights has been obtained from the National Weather Service (NWS) station number 04106 in Spokane, Washington which is representative of upper air east of the Cascade Mountains. The upper air data is read into the model in FSL format.

AERMAP

The AERMAP preprocessor required input of 10-Meter Digital Elevation Model (DEM) files which were loaded from the Geomorphological Research Group website at http://rocky.ess. washington.edu/data/raster/tenmeter/byquad/wallawalla/index.html. The website contains free 10-meter DEM files for download into AERMAP. Review of the of Washington State 10-meter DEMs plot shows "Walla Walla" quadrangle contained the necessary DEM files for the Hanford Site Boundary. The following Table 8-7 lists the DEM file numbers used in the modeling analysis:

Table 8-7: DEMs

1841	1842	1843	1844	1845	1846	1847
1941	1942	1943	1944	1945	1946	1947
2041	2042	2043	2044	2045	2046	2047
2141	2142	2143	2144	2145	2146	2147
2241	2242	2243	2244	2245	2246	2247
					2346	2347

Modeled Receptors

The modeling analysis used discrete receptor locations to identify the maximum impact for NO_2, SO_2, and $PM_{2.5}$. Because past modeling efforts showed prevailing winds to the east, a receptor grid with 500-meter spacing was extended 10 kilometers around the eastern property boundary to be sure that the maximum impacts were identified. In addition, the Energy Northwest Columbia Generating Station was also considered since there is on-site public access. A receptor location near the city of West Richland was also considered. A total of 1811 receptor locations have been modeled to determine the highest ground-level concentration at an offsite receptor.

$PM_{2.5}$ Average Annual and 24-hr Impacts

The maximum annual average $PM_{2.5}$ concentration from the WTP project was calculated using the AERMOD model. The highest annual average impact at an offsite receptor point was calculated to be 0.010 $\mu g/m^3$. Combining the background concentration of 5.9 $\mu g/m^3$ with the WTP impact results in a total ambient air impact of 5.91 $\mu g/m^3$ which is less than the 15 $\mu g/m^3$ NAAQS. Table 8-8 illustrates the results.

Table 8-8: Summary of Annual $PM_{2.5}$ Modeled Impacts and Comparison to NAAQS

WTP AERMOD Results (ug/m3)	Background Concentration (ug/m3)	Total Ambient Impacts (ug/m3)	Annual PM2.5 NAAQS (ug/m3)	Exceed NAAQS? (Yes or No)
0.010	5.9	5.91	15	No

The highest 24-hr impact at an offsite receptor was calculated to be 0.445 $\mu g/m^3$. Combining the background concentration of 15 $\mu g/m^3$ results in a total impact of 15.445 $\mu g/m^3$ which is less than the 35 $\mu g/m^3$ NAAQS. These results are presented in Table 8-9.

The location of the maximum concentrations is the elevated terrain to the east of the WTP facility, across the Columbia River in the Ringold and White Bluffs area.

Table 8-9: Summary of 24-Hr $PM_{2.5}$ Modeled Impacts and Comparison to NAAQS

WTP AERMOD Results (ug/m3)	Background Concentration (ug/m3)	Total Ambient Impacts (ug/m3)	24-hr PM2.5 NAAQS (ug/m3)	Exceed NAAQS? (Yes or No)
0.445	15	15.445	35	No

NO_2 Maximum 1-hr Impact

The 1-hr NO_2 standard is defined as the "3-year average of the 98th percentile of the annual distribution of daily maximum 1-hour concentrations." Modeling this standard requires selecting certain options in the BEEST software to compare to the NAAQS. This involved specifying the pollutant name as "NO_2," selecting the 1-hour averaging period, and selecting the 8th highest value at each receptor. Results of the analysis in Table 8-10 show the maximum concentrations to the east of the WTP facility, across the Columbia River in the Ringold and White Bluffs area. Combining the background concentration of 12.2 $\mu g/m^3$ with the WTP results of 55.46 $\mu g/m^3$ shows a total ambient impact of 67.88 $\mu g/m^3$ which is less than the NAAQS value of 188 $\mu g/m^3$.

Table 8-10: Summary of 1-Hr NO_2 Modeled Impacts and Comparison to NAAQS

WTP AERMOD Results (ug/m3)	Background Concentration (ug/m3)	Total Ambient Impacts (ug/m3)	1-hr NO2 NAAQS (ug/m3)	Exceed NAAQS? (Yes or No)
55.46	12.2	67.66	188	No

SO_2 Maximum 1-hr Impact

The 1-hr SO_2 standard is defined as the "3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations." Modeling this standard involved selecting certain options in the BEEST software to compare to the NAAQS. This included specifying the pollutant name as "SO_2," and selecting the 1-hour averaging period, and selecting the 4th highest value at each receptor. The table 8-11 results showed that the maximum concentration were located to the east of the WTP facility, across the Columbia River in the Ringold and White Bluffs area. Since background concentrations of SO2 were not available, the total ambient impact of 1.22 $\mu g/m^3$ is less than the NAAQS value of 196 $\mu g/m^3$.

Table 8-11: Summary of 1-Hr SO_2 Modeled Impacts and Comparison to NAAQS				
WTP AERMOD Results (ug/m3)	Background Concentration (ug/m3)	Total Ambient Impacts (ug/m3)	1-hr NO2 NAAQS (ug/m3)	Exceed NAAQS? (Yes or No)
1.22	No Data Available	1.22	196	No

Far Field Impacts to Class I Areas

Screening to evaluate the projects impact to the nearest Class I Areas was performed in accordance with the Federal Land Managers Air Quality Related Values Work Group (FLAG) Phase I Report - Revised 2010. The FLAG document recommends that initial screening based on a sources potential emissions in tons per year (Q) divided by the distance to the nearest class I area (D) can be performed on sources greater than 50 kilometers (km) from a Class I Area. The nearest Class I Area to the WTP is the Alpine Lakes Wilderness Area which is located 137 km away. If the Q/D value is less than 10, a source is considered to have an insignificant impact to the nearest Class I area and no further impact review is required. The screening procedure is described on Page 18 and 19 of the FLAG 2010 document.

The emission rate values identified in Table 8-12 below were taken from Table 5-2. Note that per the FLAG guidance, the emergency turbines, type I emergency generator, and fire pump emissions were converted to an annualized rate based on 8,760 hr/yr as required for screening purposes. Their maximum projected emission rates in table 5-2 are much lower than the screening values due to limited hours of operation.

The nearest Class I Area is the Alpine Lakes Wilderness Area which is 137 kilometers from the WTP Project. Results of the screening show that the Q value equals 1,110 tons per year. Performing the Q/D calculation results in a value of 8.1 which is less than the screening threshold of 10. Sulfuric acid H_2SO_4 mist was not included in the screening because emission factors were not available in AP-42 or by the manufacturer for the diesel combustion units, and Process Facility emission units assumed that all sulfur was converted to SO_2.

Table 8-12 Class I Area Screening Analysis

Pollutant	Boilers (ton/yr)	Type I generator (ton/yr)	Turbine Generators (ton/yr)	Fire Pumps (ton/yr)	PT Facility (ton/yr)	LAW Vit (ton/yr)	HLW Vit (ton/yr)	WTP Total Q Value (ton/yr)	Distance to Nearest Class I Area D Value (km)	**Q/D Value**
NO_x	84.3	286.1	611.4	29.5	0.4	36.7	8.5	1057.0	137.0	7.7
SO_2	2.9	0.4	2.1	0.0	0.0	3.7	4.8	14.0	137.0	0.1
PM_{10}	18.7	9.5	5.5	0.4	2.0	1.6	1.2	38.9	137.0	0.3
								1,110	137.0	**8.1**

Appendix A Air Emissions Estimates Supporting Supplemental PSD Air Permit Application

Objective

The objective of this emission estimate is to support submittal of a supplemental air permit application to the Washington State Department of Ecology for incorporating WTP design changes associated with substituting turbine generators for the previously permitted Type II diesel generators. The estimate also supports increasing the annual operating hours for the diesel fire pumps from 110 hours per year each to 230 hours per year each. The emission estimate provides examples of the methodology used to estimate maximum potential air emissions required by WAC 173-400-700 "General Regulations for Air Pollutant Sources."

The emission estimate is prepared consistent with the *Engineering Studies Procedure* N/A16, Section 3.3.2 because it does not support and is not intended to be used as input to WTP design. The emission estimate describes the method used to estimate emissions for air permitting purposes.

Inputs

There are no design inputs associated with this estimate since it does not support WTP design.

Background

The WTP Project has determined that substituting turbine generators for emergency power supply is a better alternative to the previously planned Type II diesel generators for Nuclear Safety required backup power supply. Because the WTP PSD-02-01 Air Permit approval is based on diesel generator design, amendment to the permit and Ecology Approval are necessary prior to installation to ensure applicable regulatory requirements are met.

The additional annual operating hours for the diesel engine fire pumps are being pursued to support necessary startup and testing of fire systems.

Applicable Codes and Standards

There are no engineering design codes or standards associated with this estimate since it is not used for design of the WTP.

- From an air permitting perspective, WAC 173-400 is the regulatory driver behind preparation of air emission estimates to support *Prevention of Significant Deterioration Permit Application Supplement to PSD-02-01, Amendment 2*, 24590-WTP-RPT-ENV-12-001.

Methodology

The methodology used to estimate criteria pollutant emissions includes employing manufacturer emissions data as the basis for estimating emissions from the diesel combustion units. If manufacturer emission factors are not available for certain pollutants, then EPAs AP-42 emission factors were used. The emissions factors are then multiplied or divided by common unit conversion factors to calculate emissions data for comparison to applicable regulatory standards.

The following example equations provide the methodology used to prepare the emission estimates.

Criteria Pollutant Emissions from Turbines

The equation for annual turbine maximum projected emissions in tons per year using manufacturer emissions data is as follows:

- **Emissions (ton/yr)** = Number of turbines * annual operating hours (hr/yr) * Vendor emission rate (lb/hr) * conversion to tons (ton/lb)

The equation for annual turbine emissions in tons/yr using AP-42 data is as follows:

- **Emissions (tons/yr)** = Number of turbines * annual operating hours (hr/yr) * AP-42 factor (lb/1000gal) * turbine fuel use rate (1000 gal/hr) * Conversion to tons/lb

Criteria Pollutant Emissions for Diesel Fire Pumps

The equation for annual fire pump maximum projected emissions in tons per year using manufacturer emissions data is as follows:

- **Emissions (ton/yr)** = Number of engines * annual operating hours (hr/yr) * generator output (hp) * vender emission rate (lb/hp-hr) * convert to tons (ton/lb)

Assumptions

There are no assumptions.

Calculation Examples

Criteria Pollutant Emissions for Turbine

The emissions of NO_x and CO_2 are used for the examples. The identical methodology is used for all other pollutants.

Data

Rolls-Royce NO_x Emission Rate = 69.8 lb/hr (Reference 1)
AP-42 CO_2 Emission Factor = 157 lb/MMBtu * 139 MMBtu/1000 gal = 21,823 lb/1000 gallons (Ref 4)
Number of Turbines = 2
Annual operating hours = 164 hr/yr
1 pound = 0.0005 ton
Turbine Max Fuel Use Rate = 0.378 10^3 gallons/hr (Reference 2)

Using Rolls-Royce Data

- Annual NO_x Emissions = (2 turbines) * (69.8 lb/hr) * (164 hrs/yr) * (0.0005 ton/lb)
  = 11.45 tons/yr

Using AP-42 Data

- Annual CO_2 Emissions = (2 turbines) * (164 hrs/yr)*(157 lb/MMBtu*139 = 21,823 lb/10^3gal)
  * 0.378 10^3 gal/hr) * (0.0005 ton/lb)
  = 1,353 tons/yr

Criteria Pollutant Emissions for Diesel Fire Pumps

The emissions of NO_x are used for the example.

Data

NO_x Emission Rate = 5.1 gram/hp-hr (Reference 3)
1 pound = 453.59 grams
Number of Diesel Eng. = 2
Diesel Engine Output = 300 hp
Annual operating hours = 230 hr/yr
1 pound = 0.0005 ton

- Annual NO_x Emissions = (2 fire pumps) * (230 hr/yr)*(300 hp)*(5.1 g/hp-hr)*(1lb/453.59 g)
  * (0.0005 ton/lb)
  = 0.78 tons/yr

A complete summary of all criteria pollutants are provided in the tables below. Note that GHG calculations of $CO2_e$ only included CO_2 emissions since EPAs AP-42 does not include emission factors for other GHG species.

Results and Conclusions

Criteria Pollutants

Results of criteria pollutant emission estimates show that there has been an overall WTP NO_x and particulate matter emissions reduction associated with utilizing turbine generators instead of the previous Type II diesel generators and considering the additional fire pump operating hours. There has been a slight increase in overall emissions of CO, VOC, and SO_2 however the increases are below PSD significance thresholds.

Since WTP previously exceeded the PSD significance levels for NO_x and PM_{10}, these pollutants were of primary concern when considering turbine generators over diesel generators. Review of Table 5-1 above shows that both the Type I and Type II diesel generators contributed approximately 20.4 tons of NO_x and less than 1 ton of PM_{10} each year. Since the Type I generator is not being changed, the emissions from the Type II generators were removed to show that 5.4 tons of the 20.4 tons of NO_x are contributed by the Type I units. Therefore the Type II generators accounted for 15.0 tons per year. Results of this estimate show that turbines will generate 11.45 tons of NO_x per year considering an identical operating hour restriction of 164 hrs per year as used for the Type II diesel engines. Factoring in the 0.41 ton per year increase in NOx emissions from the additional fire pump operating hours, overall WTP emissions of NO_x are being decreased by approximately 3 ton per year from previously permitted levels

Review of particulate matter emission rates shows a slight reduction due to clean burning turbine engines. Review of other criteria pollutant emissions of SO_2, VOC, and CO shows slight increases but the increases are below PSD significance levels.

Review of GHG emissions shows that 1,432 tons of CO_2 may be emitted.

References

1. 24590-CD-POA-MUTC-00001-02-00001, Rev C *Rolls-Royce Corporation Industrial Engine Performance & Emissions*
2. 24590-CD-POA-MUTC-00001-02-00002, Turbine Fuel Flow Rate
3. 24590-WTP-HAC-50-0006, Sheet 24 (Diesel Generator) and Sheets 28&37 (Fire Pump)
4. AP-42, Compilation of Emiss Factors Chapter 3.1, Stationary Gas Turbines, (www.epa.gov/ttn/chief/ap42/ch03/final/c03s01.pdf)
5. 24590-WTP-HAC-50-0006, *Prevention of Significant Deterioration Air Emissions Calculation*
6. 24590-WTP-RPT-ENV-01-006, Rev. 1, *Prevention of Significant Deterioration Permit Application for the WTP*

Table 1: Criteria Pollutant Emissions Comparison Diesel Generators VS Combustion Turbines

Existing Design - Two 5,530 Hp Type II Diesel Engine Emergency Generators

Pollutant	Number of Diesel Engines	Op. Hours per year per generator (hr/yr)	Generator Size (Hp)	Emission Factor (lb/hp-hr)	Conversion (lb to tons)	Annual Gen Emissions (Ton/yr)
NOx	2	164	5530	1.65E-02	0.0005	15.0
CO	2	164	5530	1.98E-03	0.0005	1.80
SOx	2	164	5530	2.43E-05	0.0005	0.02
PM	2	164	5530	5.51E-04	0.0005	0.50
VOC	2	164	5530	6.61E-04	0.0005	0.60

Notes

1. The emission factors for NOx, CO, PM and VOCs are based on vendor quotes for a 2500 KW generator (24590-WTP-HAC-50-00006, Rev A Sheet 24).
2. The emission factor for SO_2 is based on EPA AP-42, Section 3.4, Table 3.4-1.A for large stationary diesel engines. http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s04.pdf

3/ Sulfur content is based on 30 ppm sulfur diesel fuel.

New Design - Two 3.8 MW Diesel Combustion Turbine Emergency Generators

Pollutant	Number of turbines	Op. Hours per year per turbine (hr/yr)	Turbine Emission Rate (lb/hr)	Conversion (lb to tons)	Annual Turbine Emissions (Tons/yr)
NOx	2	164	69.8	0.0005	11.45
CO	2	164	38.6	0.0005	6.33
SO2	2	164	0.24	0.0005	0.04
HC (VOC)	2	164	11	0.0005	1.80

Note: Turbine emission factors based on 24590-CD-POA-MUTC-00001-02-00001, Rev. C "Rolls-Royce Corporation Industrial Engine Performance & Emissions Estimate (EDR 19252I) for Engine Configuration 501-KB7, Uncontrolled Emissions, ultra-low sulfur (15 ppm) diesel fuel

	Number of turbines	Op. Hours per year per turbine (hr/yr)	[2]Fuel Consumption Rate (1000 gal/hr)	AP-42 PM Emission Factor (lb/1000 gal)	Conversion (lb to tons)	Annual Turbine Emissions (Tons/yr)
PM_{total}	2	164	0.378	1.67	0.0005	0.1
PM_{10}	2	164	0.378	1.00	0.0005	0.06
$PM_{2.5}$	2	164	0.378	0.6	0.0005	0.04
CO_2	2	164	0.378	21823	0.0005	1352
Pb	2	164	0.378	0.002	0.0005	1.21E-04

Notes

1. Turbine fuel consumption rate based on Rolls Royce data, 24590-CD-POA-MUTC-00001-02-00002.
2. Emission Factors from AP-42, Fifth Edition, Volume 1, Chapter 3.1, Stationary Gas Turbines, (http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s01.pdf)
3. Emission factors based on an average distillate oil heating value of 139 MMBtu/1000 gallons. To convert from (lb/MMBtu) to (lb/1000 gallons), multiply by 139
4. Assume filterable PM from AP-42 is 2.5 micron in size.

Table 2: Criteria Pollutant Emissions from Diesel Driven Fire Pumps									
Existing Diesel Fire Pump Emissions Operating 110 hours per year each									
Pollutant	**Number of Diesels**	**Op. Hours per year per generator (hr/yr)**	**Generator Size (Hp)**	**Emission Factor (gm/hp-hr)**	**Emission Factor (lb/hp-hr)**	**Conversion (lb to tons)**	**Annual Gen Emissions (Ton/yr)**		
NOx	2	110	300	5.1	0.0112	0.00050	0.37		
CO	2	110	300	0.22	0.0005	0.00050	0.02		
SOx	2	110	300	0.0042	9.26E-06	0.00050	0.00		
PM10	2	110	300	0.07	0.0002	0.00050	0.01		
VOC	2	110	300	0.07	0.0004	0.00050	0.01		
Proposed Diesel Fire Pump Emissions Operating at 230 hours per year each									
Pollutant	**Number of Diesels**	**Op. Hours per year per generator (hr/yr)**	**Generator Size (Hp)**	**Emission Factor (gm/hp-hr)**	**Emission Factor (lb/hp-hr)**	**Conversion (lb to tons)**	**Annual Gen Emissions (Ton/yr)**		
NOx	2	230	300	5.1	0.0112	0.00050	0.78		
CO	2	230	300	0.22	0.0005	0.00050	0.03		
SOx	2	230	300	0.0042	9.26E-06	0.00050	0.0006		
PM	2	230	300	0.07	0.0002	0.00050	0.01		
VOC	2	230	300	0.07	0.0002	0.00050	0.01		
CO2	2	230	300		1.15	0.00005	79.35		
Notes									
1. The emission factor for Nox, SO2, CO, VOC and PM are based on vendor emissions identified in 24590-WTP-HAC-50-00006 Sheets 28 and 37									
2. The vendor factor for SO2 was based on 0.05% S fuel. Adjusted to 0.0015% for ultra low sulfur fuel by multiplying by a ration of 0.000015/0.0005.									
3. CO2 emission rate based on AP-42, Chapter 3.3, Gasoline and Diesel Industrial Engines (http://www.epa.gov/ttn/chief/ap42/ch03/final/c03s03.pdf)									
4. The VOC calculation was based on total hydrocarbon emissions.									